4.1 Accelerated Motion

I. Newton's Second Law

A. Newton's 2nd Law - a net force on an object causes the object to accelerate in the direction of that force

1. Acceleration is determined by the size of the object's mass and the size of the force
   a. a larger mass requires a larger force
   b. a smaller mass requires a smaller force

II. The Force equation

A. Newton's 2nd Law can be expressed as an equation

→ $F = ma$ (F = force, m = mass, a = acceleration

Oct 31-9:30 AM

III Falling Objects

A. Objects, despite mass, fall at the same rate (accel. of gravity is the same)
   1. a bowling ball falls at the same rate as a marble (minus air resistance)

B. Acceleration caused by gravity = $9.8 m/s^2$
   1. $F = ma$, $W = ma$ → weight = mass · accel.

C. Air resistance
   1. Acceleration due to gravity (g) is the same for all objects, regardless of mass
   2. Anything that moves in Earth's atmosphere is affected by air resistance

Oct 31-10:40 AM

3. Air resistance - the force air exerts on an object

4. The amount of air resistance of an object depends on how much surface area an object has

IV Terminal velocity

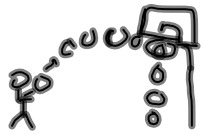
A. The highest velocity an object can achieve is terminal velocity

Oct 31-10:50 AM

4.2 Projectile and Circular Motion

I. Anything that is thrown or shot through the air is a projectile

A. Because of Earth's gravitational pull and their own inertia, projectiles follow a curved path



1. They (projectiles) have both forward (horizontal) and vertical velocities

II Horizontal motion

A. When you throw a ball, the force from your hand makes the ball move forward

1. This is known as horizontal motion

Nov 5-10:05 AM

III Vertical Motion
A. When you let go of an object, gravity starts pulling it down
1. This is known as vertical motion

IV. Motion along Curves
A. When a bicyclist or a car driving enters a curve, their acceleration changes because the direction changes
1. The change in the direction of the velocity is towards the center of the curve
B. Acceleration toward the center of a curve is centripetal acceleration

Nov 5-10:53 AM

V Centripetal Force
A. In order for the bike to be accelerating, some unbalanced force must be acting on it in a direction toward the center of the curve
B. Centripetal Force - a force acting toward the center of a curved or circular path

VI Weightlessness in Orbit
A. Astronauts in orbit still experience gravity to a slight degree

VII Free-falling
A. When an object is influenced only by gravity, it is said to be in free-fall acceleration

Nov 6-10:26 AM

1. An orbiting space shuttle and all its contents are in free-fall around Earth

VIII Effects of Weightlessness

A. The resistance provided by gravity helps you exercise your body

1. Prolonged "weightlessness" can have negative effects on the body (muscle deterioration)

4.3 Sending up Satellite

I What is a satellite

A. The moon is a satellite of Earth

B. Artificial Satellites are man-made devices that orbit Earth transmitting information

Nov 6-10:40 AM

II Launching Artificial Satellite

A. Newton proposed launching satellites with a cannon

III How we use satellites

A. Communication and weather satellites are most common

IV Falling Satellites

A. Artificial Satellites cannot orbit forever, Earth's gravity and air resistance will usually cause a satellite lose energy and burn in Earth's atmosphere

V Geostationary Satellites

A. Satellites that are put into orbit that matches the speed of Earth's rotation

Nov 7-10:49 AM

4.4 Action + Reaction

I Newton's Third Law

A. Forces act in pair, called action-reaction pairs

B. Newton's 3rd Law

1. For every force there is an equal and opposite force

C. Action-Reaction Pairs

1. Jumping on a trampoline: you push the trampoline, the trampoline pushes back with an equal force

D. Forces Acting on different objects

1. When a swimmer swims, how can they move forward if forces are equal and opposite

a. The water in the pool has more mass, causing swimmer to accelerate

Nov 8-10:15 AM

2. Even though forces are equal, they are not balanced

E. Rocket Propulsion

1. The hot gases pushing out of the rocket causes a push against the rocket in the upward direction

II. Momentum - Mass on the Move

A. The amount of force required to stop a moving object is based on how much momentum an object has

1. Momentum = mass · velocity

a. Momentum has a direction because velocity has direction

Nov 8-10:40 AM

B. Conserving total Momentum
1. Momentum cannot change unless velocity, mass, or direction changes
a. Momentum can be transferred to another object
→ playing pool: pool balls struck by cue ball

C. Law of conservation of momentum –
1. The total amount of momentum of a group of objects does not change unless outside forces act on objects

Nov 9-9:40 AM

Chapter 4 Review

Grade: 11th
Subject: Physical Science
Date: 11/12

Nov 12-8:27 AM

1 A net force acting on a moving object causes the object to _____

A stop
B curve
C accelerate

Nov 12-8:29 AM

2 _____is the force of gravity on an object.

A mass
B momentum
C weight

Nov 12-8:29 AM

3 Which of these opposes acceleration due to gravity?

A air resistance
B momentum
C reaction force

Nov 12-8:30 AM

4 According to Newton's second law, _____ equals mass times acceleration.

A weight

C momentum

B force

Nov 12-8:31 AM

5 What causes a leaf to fall more slowly than a penny?

A gravity
B force

C air resistance

Nov 12-9:03 AM

6 Which best illustrates Newton's third law?

A projectile motion
B circular motion

C centripetal force

Nov 12-9:06 AM

7 The _____ velocity of a projectile is considered to be constant.

B vertical
C circular

A horizontal

Nov 12-9:07 AM

8 An object in free-fall can be considered _____.

A moving horizontally
B motionless

C weightless

Nov 12-9:08 AM

9 _____ is reached when air resistance and force due to gravity are equal.

A negative acceleration

C centripetal acceleration

B terminal velocity

Nov 12-9:09 AM

10 What does not affect the amount of air resistance that acts on an object?

MASS

Nov 12-9:10 AM

11 What force is exerted on a 1000-kg car accelerating at a rate of 15 m/s/s (answer in Newtons)?

$F = ma$

$m = 1000\ kg$

$a = 15\ m/s^2$

$F = 1000(kg) \cdot 15(m/s^2)$

$= 15000\ kg \cdot m/s^2 \rightarrow 15000\ N$

Nov 12-9:11 AM

12 The motion of a 12-kg object is opposed by a 30-N force of friction. At what rate does friction slow the object down (answer in m/s/s)?

$F = ma$

$\frac{30\ N}{12\ kg} = \frac{12\ kg}{12\ kg} \cdot a \quad = 2.5\ m/s^2$

Nov 12-9:12 AM

13 A 4-kg bowling ball rolling at 6 m/s collides head on wiht an identical, motionless bowling ball. If the first ball is moving forward at 2 m/s right after the collision, what is the speed and direction of the second ball (in m/s)?

4kg ball @ 6m/s → 2m/s to right

→ 4kg ball @ 0 m/s → ? = 4m/s

$M = m \cdot v$

$4 \cdot 6 = 24$

$4 \cdot 0 = 0$ > $24 = 4(2) + 4(x)$

Nov 12-9:24 AM